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PTO 07-5259

CC=FR DATE=19990910 KIND=A1
PN=2775621

SOLID OR LIQUID PRODUCT THERMAL TREATMENT AND MIXING DEVICE [DISPOSITIF MELANGEUR ET DE TRAITEMENT THERMIQUE DE PRODUITS SOLIDES OU LIQUIDES]

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UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. JULY 2007

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(10):	FR
DOCUMENT NUMBER	(11):	2775621
DOCUMENT KIND	(12):	A1
PUBLICATION DATE	(43):	19990910
PUBLICATION DATE	(45):	
APPLICATION NUMBER	(21):	98 02530
APPLICATION DATE	(22):	19980303
ADDITION TO	(61):	
INTERNATIONAL CLASSIFICATION	(51):	B 01 F 15/06
DOMESTIC CLASSIFICATION	(52):	
DESIGNATED CONTRACTING STATES	(84):	

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APPLICANT	(71):	ETIA EVALUATION TECHNOLOGIQUE INGENIERIE ET APPLICATIONS

TITLE (54): SOLID OR LIQUID PRODUCT THERMAL TREATMENT AND MIXING DEVICE

FOREIGN TITLE (54A): DISPOSITIF MELANGEUR ET DE TRAITEMENT THERMIQUE DE PRODUITS SOLIDES OU LIQUIDS

The present invention concerns a thermal treatment and mixing /1*
device for liquid, gel or powder products, for example. Such devices can, for example, be used for drying sea salts, food products, filtrates, or even for torrefaction.

Mixing devices currently in use in industry include a fixed or moving mixing member. When it is fixed the mixing member includes a shaped component that has an external surface provided with deflectors, in such a way that when this mixing member is arranged in a flow of products it creates movements of the products that facilitates their mixing. When it is moving the mixing member includes a shaped component such as a screw, a band, a plowshare or blades, whose rotation in the enclosure that holds the products to be treated causes displacements of the latter which accelerates their mixing.

In certain cases it is necessary to subject the mixed products to thermal treatment. It is then necessary to set up an oven such as a tunnel with hot air downstream from the mixing device. However, the initiation of the thermal treatment is then onerous and the unit is relatively bulky.

In order to ameliorate this disadvantage we have researched how to carry out the thermal treatment during the mixing process.

In a first kind of mixing device that also assures thermal treatment of the products some devices for heating the enclosure that

* Numbers in the margin indicate pagination in the foreign text.

holds the products is provided, by installing the heating devices in the wall of the enclosure. Such devices are not easy to set up and start and are relatively expensive.

A second kind of device is known in which immersion heaters are arranged in the container that holds the products. Such devices are simpler to place in operation than the previously mentioned devices. /2 However, in these latter devices only the products that are in the direct vicinity of the immersion heaters are subjected to an efficient thermal flow. Moreover, it happens in this case that the immersion heaters do not induce any movement of the products, because the products found near the immersion heaters are not regularly renewed. The result is that the heating of the products is incomplete, irregular and not very effective. In order to heat the products located in a position distant from the immersion heaters it is then necessary to increase the temperature of the latter, which poses a risk of causing the products near the immersion heaters to stick because of excessive heating of the said products, so that the maintenance costs are thereby increased (frequent cleanings are indeed mandatory to unstick the roasted products that adhere to the immersion heaters), or to heat the enclosure more, which again increases the cost of the unit.

In the field of powder products transfer, devices for the transfer and thermal treatment are known in which the transfer member is a screw with double envelope, which has an internal passage in

which one passes a heat carrier fluid through. It might have been possible to think of adapting this structure for mixing devices. However, this kind of structure has many disadvantages: in addition to the high manufacturing cost and the complexity of the installation to preserve water-tightness during rotation of the screw, the thermal inertia is very high, which prevents a quick change of the thermal conditions. This could be very important for safety in the case when a dangerous occurs, requiring one to shut down as quickly as possible the heating of the products.

In addition, it is necessary is certain mixing applications such as aerobic fermentation to provide a hollow and perforated mixing /3 member that allows the diffusion of air bubbles among the products. In a mixing device that is derived from the structure discussed previously the necessity of a heat carrier fluid traveling through the mixing member prevents such applications.

The aim of the invention is to overcome the aforementioned disadvantages by designing a device that performs better.

In order to realize this goal one provides, according to the invention, a solid or liquid product thermal treatment mixing device that includes a mixing unit placed in an enclosure intended to hold the products to be mixed and treated and a thermal treatment heating device, the mixing member having at least one external surface form of an electrically conducting material and including some means of

connection to an electric power supply source in order to itself comprise the heating device.

Thus, the heating device is comprised of the mixing member in contact with which the products for the most part brought to during the mixing process. All or nearly all of the products will therefore be heated directly in contact with the heating device, and this will be accomplished without being located against the heating surface. The heating of the products is thus accomplished uniformly and the problems of sticking are practically eliminated. Moreover, the structure of the device is simple and not very bulky, and therefore its manufacturing cost remains relatively low.

Preferably, the enclosure has at least one internal surface made of an electrically insulating material.

Because of this feature the risk of short-circuits between the mixing member and the enclosure are eliminated, just as the risks of electrocution of workers through contact with the enclosure. /4 Safety of the device is therefore reinforced.

According to one particular mode of implementation the mixing member includes a shaft provided with a shaped component, the electrically conducting material being at least provided on the external surface of the said shaft and/or the said shaped component.

According to yet another particular characteristic the shaped component is formed in its bulk of an electrically conducting

material, or its external surface is covered by a layer of electrically conducting material.

According to still another particular characteristic the shaft is formed in its bulk of an electrically material or has its external surface covered by a layer of electrically conducting material. According to one particular mode of implementation the shaft is formed of a tubular wall that defines a channel for a gas, the tubular wall with its external surface made of an electrically conducting material that has perforations.

In addition, the mixing member is installed in the enclosure in order to turn about the longitudinal axis of the shaft while being connected to the output shaft of a rotational drive motor, or is installed in fixed position in the enclosure.

Preferably, the electrically conducting material is a metal such as stainless steel.

Other characteristics and advantages of the invention will be apparent more clearly from reading the following description of the particular non-limiting modes of implementation of the invention.

We shall make reference to the attached drawings, among which:

- Figure 1 is a view of the unit, with sectional view, of a thermal treatment and mixing device according to one initial mode of implementation; /5
- Figure 2 is an elevated partial view with cut-away exposure of a device according to a second mode of implementation;

- Figure 3 is a view similar to Figure 2 of a device according to a third mode of implementation.

With reference to Figure 1, the thermal treatment and mixing device according to the invention includes a tubular enclosure 1, which is closed and includes at its respective ends, a system for the supply of products to be mixed that have been given the general reference number 2 and include for example two channels 2.1, 2.2 of powder or granulated products and a channel 2.3 for liquid product that open into enclosure 1, and a discharge outlet 3 of the mixture blocked by a shut-off valve (not shown). The enclosure 1 is preferably made of an electrically insulating material such as a plastic. The enclosure could also have only its internal surface made of an electrically insulating material. Although we have shown the enclosure 1 in the form of a complete cylinder (closed top), the enclosure 1 could also be adapted with an open top, and it could assume any shape that is adjusted to the particular application for which it is intended.

A mixing member designated generally by 5 is installed in the enclosure 1 to turn about its longitudinal axis 5.2.

In Figure 1 the mixing member 5 is here a band type mixing member that includes a shaft 5.1 that carries a shaped element 5.3 formed by two helical and coaxial coils that are wound around the shaft 5.1 in opposite directions. According to an essential

characteristic of the first mode of implementation of the invention the mixing member 5 is at least partially made of an electrically conducting material, of stainless steel for example. The shaft 5.1 /6 and/or the shaped element 5.3 can be formed in their body of electrically conducting material, or in a variant they can be made of an electrically insulating material and have an external surface made electrically conducting by depositing a layer of conducting material or conducting particles.

The end portion(s) of shaft 5.1 of the mixing member 5 are received in blades 4 (of which only one is shown in Figure 1) of the tubular enclosure 1 via the intermediary of the conducting rings secured in these blades and connected to a power source (not shown here) by electric wires 7. The power source will be sized as a function of the dimensional characteristics and of electrical resistance of the mixing member in particular. Preferably, the voltage supplied, direct or alternating, will be less than 100 volts for safety reasons. The connection devices to the supply source could be, instead of and in place of the conducting rings, conducting brushes or frictional contact carbon brushes on the external surface of the transfer member, or even a rotating connection link installed on one of the ends of the transfer member 5.

One end portion of shaft 5.1 is rotationally combined with one end of the output shaft of a rotational drive motor 8 via the intermediary of a coupling joint, of the kind with clamps for

example. The coupling joint can thus assure, in addition to a function of electrical insulation of the motor from the mixing member, a function of correction for the alignment defects between the output shaft and the end of the shaft and/or a function of elastic shock absorption.

Operationally, the mixing member 5 is rotated by the motor 8. /7 An electric current, brought from the supply source by wires 7 and the rings, crosses over the shaft 5.1 and/or the shaped element 5.3 of the mixing member 5, thus causing their hating by the Joule effect.

The powder and liquid products to be mixed and to be treated are introduced into the enclosure 1 through the supply system 2 and are mixed by the shaped element 5.3. Simultaneously, the products are heated during their mixing by their contact with the external surface of the shaft 5.1 and/or the shaped element 5.3. Because of the rotation of the latter and of the induced movements of the products, the products will be for the most part brought into contact with the heated mixing member 5. The heating of the products is thus very efficient and uniform for all or nearly all of the latter. Once the mixing is completed and the thermal treatment over, the valve of the drain outlet 3 is opened and the mixture is discharged out of the enclosure, in conformity with "batch" type use of the mixing unit (by means of successive batches).

We shall now describe two other modes of implementation with references to Figures 2 and 3.

Elements that are identical or similar to those described previously will bear the same numerical reference in the remainder of the description.

In Figure 2 the mixing member 5 of the device according to a second mode of implementation is arranged vertically in an enclosure 1 of conical shape, and it includes a shaft 5.1 that has as the longitudinal axis the vertical axis 5.2. A shaped element in the shape of a helix 5.3 of the cone-shaped Archimedes screw kind winds around the shaft 5.1.

The shaft 5.1 and the helix 5.3 are in this case made of a single piece of electrically insulating material, and the external surfaces of shaft 5.1 and the helix 5.3 are covered by a conducting /8 layer 15 comprised, for example, of stainless steel, an electrically conducting fabric, or of any other suitable electrically conducting material. Only the external surface of the helix 5.3 could also be covered by the conducting layer 15.

In a variant one could make the shaft 5.1 and the helix 5.3 of a single piece in an electrically conducting material such as a metal, or even make a shaft 5.1 of insulating material and a helix 5.3 made in its body of an electrically conducting material and secured to the shaft 5.1.

The mixing member 5 according to this mode of implementation is here intended, as previously, to be installed in turning manner in the enclosure, preferably made of an electrically insulating material, via the intermediary of blades that receive the ends of the shaft 5.1, and to be connected by rings 6 and electrical wires 7 that form associated collector devices to an electrical power source not shown here.

With reference to Figure 3 the mixing and thermal treatment device according to a third mode of implementation includes, as previously, an enclosure 1 in which a mixing member 5 is installed that can rotate.

The mixing member 5 includes here a hollow shaft 5.1 formed of a tubular wall made of an electrically conducting material. The tubular wall of shaft 5.1 is crossed by a large number of transverse perforations 5.4. The shaft 5.1 has an open end intended to be connected to a source of gas under pressure and a plugged opposite end.

The shaped element 5.3 in this case is a helix secured to one part of the shaft 5.1 that extends into enclosure 1. The shaped element 5.3 is also made of an electrically conducting material.

In operation the products arranged in enclosure 1 are mixed /9
and heated by the shaped element 5.3 that rotates in the said enclosure. Simultaneously, some gas under pressure is injected into

the tubular shaft 5.1 and escapes to the core of the products in the form of bubbles through perforations 5.4.

Such a structure of the mixing member 5 is particularly well adapted to producing aerobic fermentation of the products to be mixed.

Of course, the invention is not limited to the modes of implementation described here, and one could introduce some variants of implementation without departing from the scope of the invention as defined by the claims.

In particular, although in the described devices the mixing member is installed in revolving manner in the enclosure, one could also arrange to install the mixing member if fixed manner, the enclosure then being traversed by the flows of products to be mixed. Moreover, the mixing member can have any specially adjusted shape, with or without a central shaft.

Although the invention has been described in relation to mixing devices with band, screw, or helix, the invention can be applied to many kinds of mixing units, such as mixing units with anchor, with turbine, with plowshare, or with pig tail. In these cases, each shaped element (anchor, plowshare or other device) will have at least one external surface formed of a conducting material.

CLAIMS /10

1. Solid or liquid product mixing and thermal treatment device, which includes a mixing member (5) positioned in an enclosure (1)

that will hold the products to be mixed and treated, and a thermal treatment heating device, characterized in that the mixing member (5) has at least one external surface formed from an electrically conducting material, and in that the mixing member (5) includes some devices for connection (6, 7) to an electric power supply source to itself constitute the heating device.

2. Device according to Claim 1 characterized in that the enclosure (1) has at least one internal surface made of an electrically insulating material.

3. Device according to Claim 1 or 2 characterized in that the mixing member (5) includes a shaft (5.1) provided with a shaped element (5.3), the electrically conducting material being at least provided on the external surface of the said shaft (5.1) and/or of the said shaped element (5.3).

4. Device according to Claim 3 characterized in that the shaped element (5.3) is formed in its body of the electrically conducting material.

5. Device according to Claim 3 characterized in that a layer (15) of the electrically conducting material covers the external surface of the shaped element (5.3).

6. Device according to one of the Claims 3 to 5 characterized in that the shaft (5.1) is formed in its body of the electrically conducting material.

7. Device according to one of the Claims 3 to 5 characterized in that a layer (15) of the electrically conducting material covers the external surface of the shaft (5.1).

8. Device according to one of the Claims 3 to 6 characterized /11 in that the shaft (5.1) is formed of a tubular wall that defines a channel for a gas, the tubular wall with its external surface made of an electrically conducting material that has perforations (5.4).

9. Device according to one of the Claims 3 to 8 characterized in that the mixing member (5) is installed in the enclosure (1) in order to revolve about the longitudinal axis of the shaft (5.1) and is connected to the output shaft of a rotational drive motor (8).

10. Device according to one of the Claims 3 to 8 characterized in that the mixing member (5) is installed in fixed manner in the enclosure (1).

11. Device according to any of the preceding claims characterized in that the electrically conducting material is a metal such as stainless steel.

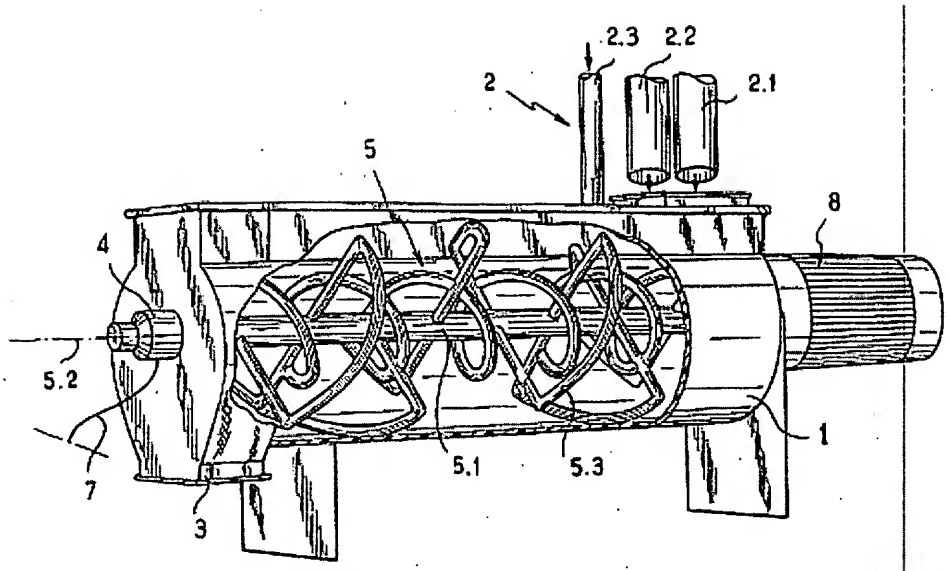

FIG_1

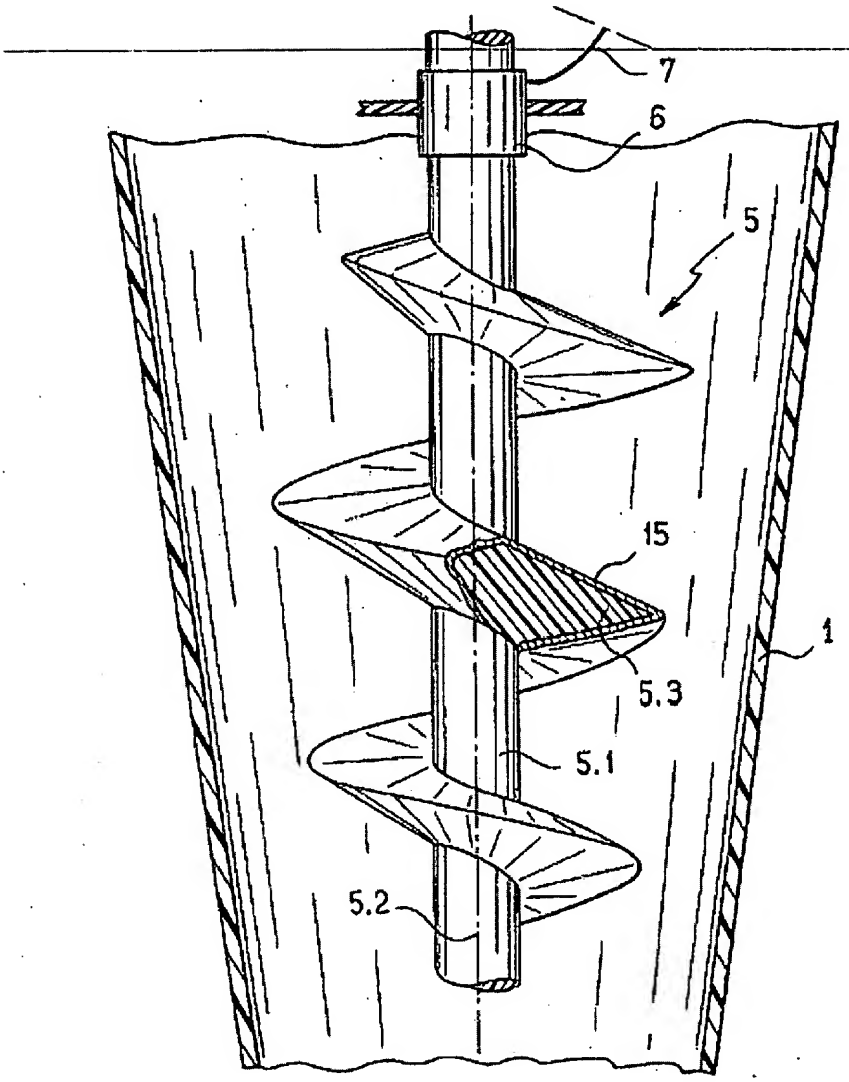

FIG_2

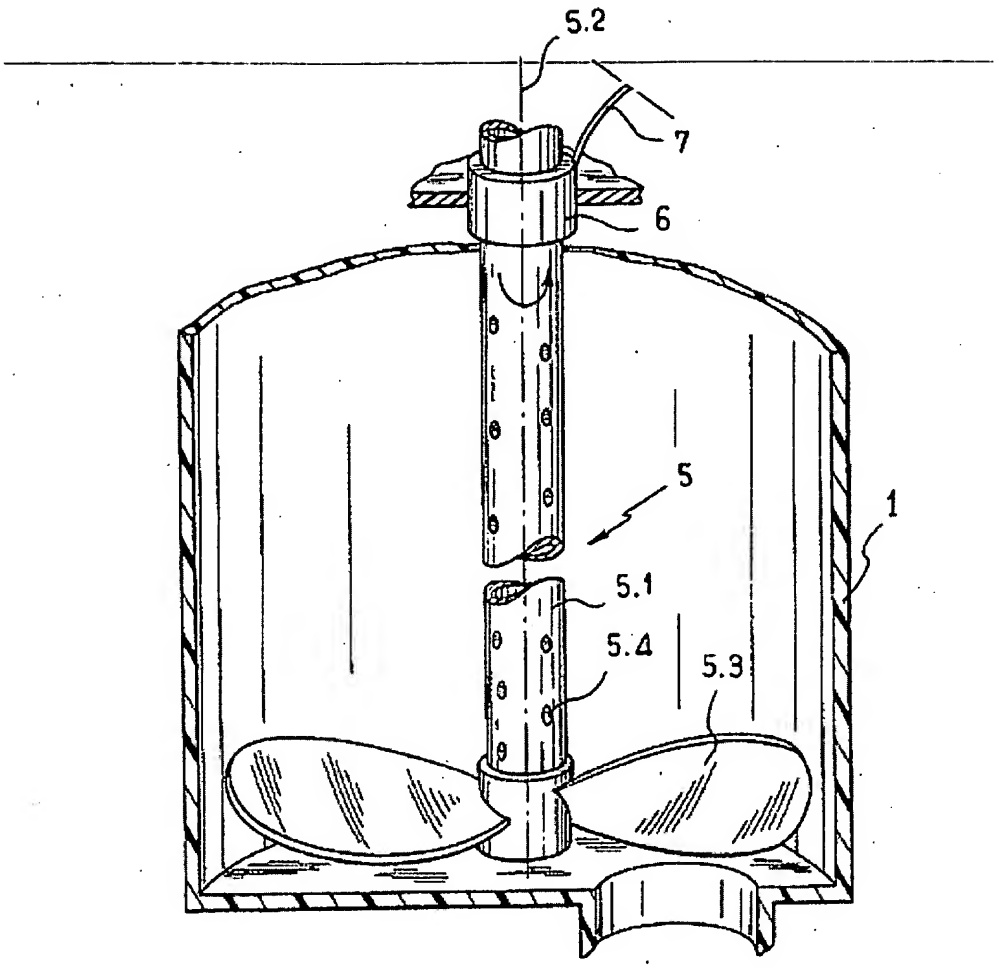

FIG.3